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ABSTRACT

This paper presents a study investigating K-8 preservice teachers' attitudes towards science in a technology-based science content course. The study was conducted in a learning environment in which hands-on science, educational technology, collaboration, and constructivism were promoted. Results suggest that using technology in classroom teaching for something other than recordkeeping or word processing encourages preservice teachers to be more informed and enthusiastic, and thus students show more self-confidence. (YDS)

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A Study of Changes in Attitude Towards Science in a Technology Based K-8 Preservice Preparation Science Classroom

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A Study of Changes in Attitude Towards Science in a Technology Based K-8 Preservice Preparation Science Classroom

Purpose of the Study

The purpose of this study was to identify and analyze changes in attitudes towards science in a technology based science content course for K-8 pre-service teachers at Black Hills State University. Given a science classroom where Internet research, hands-on science activities, cooperative group work and a constructivist learning environment is promoted, it is essential to describe how students' attitudes towards science change before and after taking a technology integrated class, for purposes of predicting the effectiveness of integrating technology into a content driven class. Since teachers are being required to integrate much more technology than ever before into their teaching this research helps rationalize that requirement while fulfilling content objectives. At the same time, science educators want to maintain a positive advance towards having more students become more literate in science. A positive attitude towards different components of education in science can facilitate both in depth and broad scale learning in science.

Theoretical Underpinnings

Attitudes associated with science are reported to be affecting student participation in science as a subject[1] and impacting performance in science.[2] An international assessment of nine-and-thirteen-year-old students in twenty countries (IAEP, 1992) revealed that positive attitudes toward science influence student performance. Positive student attitudes toward science were related to higher science performance by the majority of 13-year-old students in 15 countries.[3]

The other focus of this study was to examine the relationship of technology integration to an effective and motivating science classroom. The integration of technology is becoming a large addition to classroom teachers' daily pedagogical requirements. National and State Standards for

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[1] AAAS, 1989; Koballa, Crawley, & Shrigley, 1990.
[2] IAEP, 1992; Weiss, 1987; Linn, 1992.
[3] IAEP, 1992.

Science Teaching require that students learn the differences in, and relationships of science and technology (South Dakota State Standards for Science and Technology[4]):

> All students must recognize how developments in science impact their personal, societal, and physical environment and how scientific knowledge is developed, organized and interrelated. Scientifically and technologically literate people know how to apply the methods of science and technology for personal and professional growth and are able to use these skills for advancing community well-being.

Science teaching for grades K-12 and beyond has developed hands on, experiential methods that have been effective without adding in the mix of technology, especially as it is interpreted by non-science education literate policy makers. Too often policy makers view technology as the use of computers in settings like the modern office – word processors, data base and spreadsheet fluency, and on a rare occasion, development of presentations in programs such as PowerPoint©. Many individuals[5] are pushing technology literacy for teachers and students, but the connection to improving attitudes towards science, perception of the science teacher, the value of science in society, and the enjoyment of science, has yet to be analyzed. Given the need for technology literate educated individuals in the workplace, it is important to provide technology based learning experiences in science classes. But hands-on science teachers have some real questions about the value of replacing class time spent in practicing the processes of science with computer and other technology based experiences.

Methodology

Twenty-nine Sophomore and Junior students in a one semester four hour class took the "Assessment Of Attitude Towards Science"[6] on the first day of the "ELED 303 – Earth and Physical Science for K-8 Teachers" at Black Hills State University, taught by the researcher. It was administered anonymously to a group that consisted primarily of young women, with 20% "non-

[4] Found at URL http://www.state.sd.us/deca/TA/contentstand/Science/index.htm
[5] Norby, R. 2002.
[6] Weinberg, M. 1998.

trads", older students returning to earn a teaching certificate. The students spent 4 hours per week for 15 weeks in a university computer lab that provided one computer per student with Internet access, and with Microsoft Office, AppleWorks, and Inspiration installed, for each student. Students studied a science textbook outside of class, and completed project based activities in earth, space and physical sciences during class. Students used the Internet to research science content, lesson plans for K-8 teachers, and to access state and national science standards that included STS standards. The students took the same assessment of attitude towards science in the last week of the class.

Data Collected

Data were analyzed using SPSS Crosstabs to identify Gamma and Pearson's correlation coefficient for ordinal data. Contingency tables, generated by the SPSS procedure: CROSSTABS, were used to obtain a Gamma (G), known as Goodman and Kruskal's Gamma, which is a symmetric measure of association for ordinal-level data in this questionnaire. No specification of which variable is independent and which is dependent is necessary to use this statistic. Contingency tables show the joint distribution of two variables, without making any assumptions about the statistical distribution of the population surveyed. For these nonparametric data contingency tables can be used to evaluate relative relationships between variables.

Gamma ranges from +1.00 to –1.00.[7] A Gamma of 0.00 implies no relationship between the variables. When the value of Gamma is between 0.00 and 1.00, some intermediate amount of direct relationship between the variables can be interpreted. When the value of Gamma is between 0.00 and –1.00, some intermediate amount of inverse relationship between the variables can be interpreted. "Gamma is the most frequently used measure of association for ordinal-level and

[7] Norby, 2000.

interval-level data."[8] Gamma was computed for the change in value of each question (See Appendix A for list of questions asked) before and after taking the class, with all the other variables, in order to ascertain whether there was any change – pre and post – in attitudes. The attitudes were grouped into six groups:

Perception of the Science Teacher
Anxiety toward Science
Value of Science in Society
Self-concept of Science
Enjoyment of Science
Motivation in Science

Some statements were worded in the negative indicating that the score will be reversed. Higher numerical scores reflect more position attitudes in all area except anxiety where a lower numerical score reflects a more positive attitude (less anxiety).

Appendix B gives the list of questions with their Gamma values between each question asked before and after taking the class. The question with the highest positive Gamma was that calculated for "I have a good feeling toward science." That Gamma, of value .437, indicated a very strong positive increase in feeling towards science after taking this class. Other questions with a large positive Gamma were: "I remember most of the things I learn in science class," "It makes me nervous to even think about doing science," and questions 35, 36, 7, 28, and 17; their Gamma values ranged from .26 to .437. Other questions that had positive Gamma's of more than .09 were those of numbers 1, 25, 26, 48, 41, 16, 19 20, 21, and 22. The Gammas representing analysis of questions number 12, 27, and 28 were so close to zero that it is not likely to have any significance.

The question that had the largest negative Gamma, indicating a notable decrease from before to after was number 4, "I do not do very well in science." This indicates that students developed a more positive self-concept in science as a result of taking the technology-integrated class. The

[8] Elifson, et.al., 1982.

complete computer listing of all the Crosstabs tables generated by SPSS can be requested from the author at her e-mail address.

The perception of the Science Teacher was the variable that showed the smallest increase between pre and post assessment. Other subscales on the instrument showed decrease in anxiety towards science, and increases in motivation and enjoyment of science. On question 49, which was only asked on the post assessment, about 80% of the students, indicated that their overall attitude toward science had increased appreciably since the beginning of the course.

Analysis

The students were pre-service teachers so it would be expected that they already had a fairly positive perception of science teachers. On a formative assessment at the beginning of the semester that asked the students about their most positive experience in science learning, almost all of the individuals who responded to this question described hands-on activities and an enthusiastic science teacher. The results of data collection show that, for this group of students, use of technology in this class produced important increases in feelings of motivation, positive self-concept as a learner, and enthusiasm about science. In Appendix C, the averages of pre and post scores are given with the differences before and after. On the group of questions pertaining to the value of science in society, students did not, for the most part, change in their perspective on this topic. More students agreed and strongly agreed on this topic on the pre and post assessments.

For the group related to perception of the science teacher, on questions 1 and 4, there was a notable increase in positive attitude towards the science teacher. The combination of a teacher emphasizing herself in the role of the "guide on the side" with the use of technology in the classroom improved the students' attitudes measurably in this classroom.

For the group of questions related to anxiety towards science, there was a decrease in anxiety equivalent to half the distance between data points for the respondents in this classroom.

For the group of questions related to enjoyment of science, the students were definitely more aware of their enjoyment of science after this classroom experience.

Motivation in science was a group of responses where the students' attitudes changed very slightly. The change was to an increase in motivation, but only a very slight amount. Students were already moderately motivated to learn science at the beginning of the semester, so those results may show that the motivation was as high as can be expected, given the many claims on the time of Junior level elementary education majors.

For a comparative study, further research with similar classrooms that are taught without the presence of extensive access to technology could make an even stronger case for integration of technology into science teaching.

Implications for Classroom Teachers

Activities in this hands-on, learner-centered classroom were designed to give teachers knowledge of science content knowledge that will support the level of science they will be teaching. An outline of topics for hands-on activities for pre-certification teachers and suggested relevant science teaching standards is provided to the students at the beginning of the semester. Emphasis of connecting to national and state science standards is routine in this course. (An activity manual for the class describing classroom guided discovery sessions is in development by the author and will be available for a small fee by the end of summer 2002).

Results of this research should encourage and inspire classroom teachers to use technology and Internet access in the classrooms for other purposes than record keeping and word processing. The classroom where the students are responsible for locating and processing information, given time and autonomy to research in a fashion that suits their learning style, encourages them to be more informed and enthusiastic science teachers. These students improved their own confidence in understanding science, had a better attitude about teaching science, and can be expected to model

enthusiasm for science for their students. The science they teach will be hands-on, minds on learning, integrating technology when it enhances the lesson, not as an add-on.

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Appendix A

Questions asked On The Assessment of Attitude Towards Science

_____ 1. Science is useful for the problems of everyday life.
_____ 2. Science is something, which I enjoy very much.
_____ 3. I like the easy science assignments best.
_____ 4. I do not do very well in science.
_____ 5. Science teachers show little interest in the students.
_____ 6. Doing science labs or hands-on activities is fun.
_____ 7. I feel at ease in a science class.
_____ 8. I would like to do some outside reading in science.
_____ 9. There is little need for science in most of today's jobs.
_____ 10. Science is easy for me.
_____ 11. When I hear the word "science," I have a feeling of dislike.
_____ 12. Most people should study some science.
_____ 13. I would like to spend less time in school studying science.
_____ 14. Sometimes I read ahead in our science book.
_____ 15. Science is helpful in understanding today's world.
_____ 16. I usually understand what we are talking about in science.
_____ 17. Science teachers make science interesting.
_____ 18. I do not like anything about science.
_____ 19. No matter how hard I try, I cannot understand science.
_____ 20. I feel tense when someone talks to me about science.
_____ 21. Science teachers present materials in a clear way.
_____ 22. I often think, "I cannot do this," when a science assignment seems hard.
_____ 23. Science is of great importance to a country's development.
_____ 24. It is important to know science in order to get a good job.
_____ 25. It does not disturb me to do science assignments.
_____ 26. I would like a job, which does not use any science.
_____ 27. Science teachers know when we are having trouble with our assignments.
_____ 28. I enjoy talking to other people about science.
_____ 29. I do enjoy watching a science program on television.
_____ 30. I am good at working science labs and hands-on activities.
_____ 31. Science teachers do not seem to enjoy teaching science.
_____ 32. I like the challenge of science assignments.
_____ 33. You can get along perfectly well in everyday life without science.
_____ 34. Working with science upsets me.
_____ 35. I remember most of the things I learn in science class.
_____ 36. It makes me nervous to even think about doing science.
_____ 37. I would rather be told scientific facts than find them out from experiments.
_____ 38. Most of the ideas in science are not very useful.
_____ 39. It scares me to have to take a science class.
_____ 40. Science teachers are willing to give us individual help.
_____ 41. The only reason I am taking science is because I have to.
_____ 42. It is important to me to understand the work I do in the science class.
_____ 43. I have a good feeling toward science.
_____ 44. Science teachers know a lot about science.
_____ 45. Science is one of my favorite subjects.
_____ 46. Science teachers do not like students to ask questions.
_____ 47. I have a real desire to learn science.
_____ 48. If I don't see how to do a science assignment right away, I never get it.
_____ 49. Asked Only on post assessment - I have developed a more positive attitude towards science as a result of taking this class

Appendix B

Gammas Between Questions on Pre and Post Assessment of Attitude Towards Science

Relationship of Pre or Post with each Question

Analysis using Gamma sorted by Descending Value of Gamma

Question Asked	Gamma
43. I have a good feeling toward science.	0.437
18. I do not like anything about science.	0.408
35. I remember most of the things I learn in science class.	0.374
36. It makes me nervous to even think about doing science.	0.311
7. I feel at ease in a science class.	0.296
28. I enjoy talking to other people about science.	0.273
17. Science teachers make science interesting.	0.26
1. Science is useful for the problems of everyday life.	0.233
25. It does not disturb me to do science assignments.	0.222
26. I would like a job, which does not use any science.	0.221
48. If I don't see how to do a science assignment right away, I never get it.	0.216
41. The only reason I am taking science is because I have to.	0.171
16. I usually understand what we are talking about in science.	0.168
19. No matter how hard I try, I cannot understand science.	0.156
45. Science is one of my favorite subjects.	0.147
37. I would rather be told scientific facts than find them out from experiments.	0.139
21. Science teachers present materials in a clear way.	0.137
32. I like the challenge of science assignments.	0.101
34. Working with science upsets me.	0.09
46. Science teachers do not like students to ask questions.	0.075
10. Science is easy for me.	0.033
38. Most of the ideas in science are not very useful.	0.033
40. Science teachers are willing to give us individual help.	0.027
20. I feel tense when someone talks to me about science.	0.021
12. Most people should study some science.	-0.02
2. Science is something, which I enjoy very much.	-0.033
47. I have a real desire to learn science.	-0.033
30. I am good at working science labs and hands-on activities.	-0.042
6. Doing science labs or hands-on activities is fun.	-0.048
44. Science teachers know a lot about science.	-0.049
31. Science teachers do not seem to enjoy teaching science.	-0.054
22. I often think, "I cannot do this," when a science assignment seems hard.	-0.057
14. Sometimes I read ahead in our science book.	-0.059
9. There is little need for science in most of today's jobs.	-0.064
8. I would like to do some outside reading in science.	-0.071
39. It scares me to have to take a science class.	-0.097
29. I do enjoy watching a science program on television.	-0.119
3. I like the easy science assignments best.	-0.123
23. Science is of great importance to a country's development.	-0.128
33. You can get along perfectly well in everyday life without science.	-0.136
24. It is important to know science in order to get a good job.	-0.172
27. Science teachers know when we are having trouble with our assignments.	-0.203

Appendix B -- Continued -- Relationship of Pre or Post with each Question

15. Science is helpful in understanding today's world.	-0.21
42. It is important to me to understand the work I do in the science class.	-0.213
13. I would like to spend less time in school studying science.	-0.229
5. Science teachers show little interest in the students.	-0.303
11. When I hear the word "science," I have a feeling of dislike.	-0.32
4. I do not do very well in science.	-0.327

Appendix C

Changes in Responses to Questions from Pre to Post

POST Fa 01	PRE Fall 01	Difference (Post - Pre)	Question #
1.78	2.07	-0.29	1
2.93	2.87	0.06	2
2.26	2.07	0.19	3
3.26	2.67	0.59	4
4.00	3.67	0.33	5
1.26	1.50	-0.24	6
2.78	3.40	-0.62	7
3.37	3.30	0.07	8
3.96	4.03	-0.07	9
3.33	3.67	-0.33	10
3.30	3.07	0.23	11
1.70	2.07	-0.36	12
3.07	3.07	0.01	13
4.11	4.27	-0.16	14
1.89	2.20	-0.31	15
2.44	3.07	-0.62	16
2.52	3.27	-0.75	17
3.67	4.53	-0.87	18
3.48	4.17	-0.69	19
3.48	3.97	-0.49	20
3.00	3.70	-0.70	21
2.89	3.47	-0.58	22
1.85	2.47	-0.61	23
2.93	3.57	-0.64	24
2.59	3.60	-1.01	25
2.81	3.77	-0.95	26
3.19	3.70	-0.51	27

APPENDIX C Continued

POST Fa 01	PRE Fall 01	Difference (Post - Pre)	Question #
3.22	4.33	-1.11	28
2.93	3.67	-0.74	29
2.00	3.03	-1.03	30
3.52	4.53	-1.01	31
3.04	4.13	-1.10	32
3.74	4.57	-0.83	33
3.56	4.63	-1.08	34
2.85	4.50	-1.65	35
3.37	4.77	-1.40	36
3.93	5.13	-1.21	37
3.78	5.03	-1.26	38
3.30	4.27	-0.97	39
2.44	3.73	-1.29	40
1.96	3.60	-1.64	41
2.11	3.27	-1.16	42
2.63	4.50	-1.87	43
2.00	3.40	-1.40	44
3.56	5.07	-1.51	45
3.81	5.37	-1.55	46
3.07	4.60	-1.53	47
3.19	4.83	-1.65	48
2.67			49

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